This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

TRANSPORTATION LIBRARY
V
830
.J36

A 753,048 DUPL

QUESTIONS OF THE DAY, NO. CXXL

ERICSSON'S DESTROYER AND SUBMARINE GUN

BEING A CONSIDERATION OF THEIR APPLICATION TO NAVAL WARFARE, THE ADVANTAGES OF THE SYSTEM, TOGETHER WITH A SHORT HISTORY OF SUBMARINE ARTILLERY

BY

WILLIAM H. JAQUES

LIEUTENANT U. S. NAVY

NEW YORK & LONDON
G. P. PUTNAM'S SONS
The Knickerbocker Press
1883

PROPERTY OF
University of
Michigan
Libraries
1817
ARTES SCIENTIA VERITAS

QUESTIONS OF THE DAY, No. XXXI.

ERICSSON'S DESTROYER

AND

SUBMARINE GUN

BEING A CONSIDERATION OF THEIR APPLICATION TO NAVAL WARFARE, THE ADVANTAGES OF THE SYSTEM, TOGETHER WITH A SHORT HISTORY OF SUBMARINE ARTILLERY

BY

WILLIAM H. JAQUES

LIEUTENANT U. S. NAVY

NEW YORK & LONDON

G. P. PUTNAM'S SONS

The Knickerbocker Press

1885

DEDICATED TO

THE ADMIRAL

OF

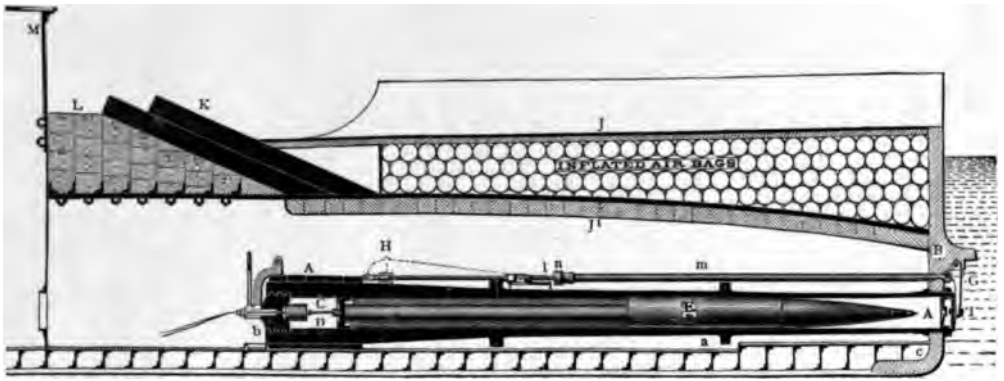
THE UNITED STATES NAVY

BY

THE AUTHOR

Transportation
Library

COPYRIGHT BY
W. H. JAQUES
1885



LONGITUDINAL SECTION OF THE BOW OF AN IRON VESSEL OF THE "DESTROYER" SYSTEM.

Specially arranged for attacking iron-clad ships carrying 120-ton guns.

ERICSSON'S DESTROYER

AND

SUBMARINE GUN.

BY

LIEUTENANT W. H. JAQUES, U. S. NAVY.

IN the December *Century* Captain Ericsson has concluded his interesting paper, "The Monitors," with a short reference to his application of submarine artillery to the *Destroyer*.

The great interest manifested in this method of warfare at the present moment in Europe has suggested the following sketch of the progress that submarine artillery has made since the year 668, the advanced point to which Capt. Ericsson has brought it, and the advantages the system possesses. Opinions differ so widely as to the character and size of torpedo-boats, and as to their efficiency, that it would be next to impossible to indicate any iron-clad rules to be followed; but in estimating the efficiency of submarine artillery these elements need not be considered, since the submarine gun can be as surely applied to the 10,000-ton armor-clad as to the iron vessel, one hundred and thirty feet long, to which Captain Ericsson has given the name of *Destroyer*.

Of the necessity of boats fitted with torpedoes or submarine projectiles there is no longer any doubt. All of the modern armed powers are supplying themselves with torpedo-boats of some type as rapidly as purchase or their workshops can provide. Germany alone, even with a limited coast-line, considers that one hundred and fifty torpedo-boats will be necessary to properly defend her coasts.

As these must have projectiles of some sort, a type or types must be determined.

Lieutenant-Commander Bradford, U. S. N., in his history of torpedo warfare, has presented a valuable outline of the subject from the idea conceived by David Bushnell, of Connecticut, in the year 1771—to destroy a ship with the gas liberated by the ignition of gun-powder under her—to the development of the Whitehead in 1882; and Lieutenant-Commander Barber, U. S. N., has contributed a short but interesting history of submarine artillery.

Captain Ericsson has deemed it necessary to state that the *Destroyer* is not, as has been generally supposed, a torpedo-boat, but a vessel of war (a gunboat if you choose) partially armored to attack bows on at short range. No matter, however, by what name she is designated, she belongs to that *family* of weapons so greatly needed for the defence of our extensive coast-line; and if we employ the accepted definition of a torpedo—"an engine or machine invented for the purpose of destroying ships by blow-

ing them up"—we should class her with torpedo-boats.

According to Barber (1875):

Causing destruction to an enemy's vessel by projecting some inflammable substance against her bottom is by no means a new idea, the earliest attempts being in the use of Greek fire, projected by means of force-pumps underneath the surface of the water. The invention is generally assigned to Callinique, the Syrian, in the year 668, although it is asserted by some that even he only revived an older invention long known to the Assyrians and Persians, and it is not until many centuries later that we find mention of powder being used in any thing pertaining to the form of a gun to project a ball under water. In 1797 Reveroni Saint Cyr, a Frenchman, proposed a form of catamaran. His piece was a 48-pounder carronade, and it was to be towed underneath a vessel by a span extending between two small boats.

Fulton, however, may be said to have made the first practical attempts at firing a gun under water in the fall of 1814, when he experimented with guns of various calibres in New York Harbor. His method of ignition was by dropping a coal of fire down a tube, which extended from above the surface of the water to the vent of the gun. With one of these guns he succeeded in penetrating a bulkhead corresponding to the bottom of a ship of the first class at a distance of 12 or 15 feet. Soon after this he designed a submarine battery of columbiads, throwing a ball of 100 pounds' weight.

The idea of a submarine gun was again put in practice by Mr. Phillips, of Indiana, who, about 1855, experimented with a small 6-pounder in a submarine boat, firing shot up through the bottom of hulks that had been anchored for the purpose; and in 1861 Mr. Woodbury, of Boston, submitted plans to the Navy Department for firing guns under water from the sides of ships, but they were not favorably received. In 1862 he made a

series of experiments, in which some thirty or forty shots were fired horizontally at a target, from 6 to 8 feet below the water line, through a stuffing-box made in the gate of a dry-dock in East Boston. The gun was a 12-pounder bronze howitzer.

The favorable nature of these experiments induced Mr. R. B. Forbes, of Boston, to make a contract with the government, in 1862, to build a small gunboat carrying a 7-inch rifle in the bow to fire under water. He was, however, obliged to give up the contract on account of the rise in the price of iron, and the project was never carried out.

In 1862 the United States Government also made a few experiments in New York Harbor with an apparatus called "Jones' Submarine Battery," which was simply a gun anchored at the bottom with the muzzle up.

Since 1861 Mr. Woodbury has at various times been in communication with the Navy Department on the subject of his submarine gun, and commissions before whom it was laid in 1864 and 1870 reported favorably upon it, but nothing has been done in the way of government experiments on the subject. Since 1864, however, the inventor has, of course, made many alterations in his designs. He now proposes that his gun be made of phosphor bronze of about twice the length of an ordinary gun, and that it shall be fired by electricity, the battery being in the pilot-house.

At the French Exposition of 1867 there was shown, in the American section, a submarine gun, designed by a gentleman named Duffy. According to the *Revue Maritime et Coloniale*, this gun had a form nearly cylindrical, and was loaded at the breech. It was put in battery on going into action by traversing an orifice pierced in the side of the ship, and a water-tight chamber in the prolongation of this orifice. The muzzle was prolonged by a tube which carried a light disc, serving to keep out the water. This disc was intended to be broken, being replaced after each discharge. The gun was discharged by a spring which served to pull down a cock on to a nipple screwed

into the breech, being disposed in such fashion as to come into play at the moment when, by contact with the enemy's vessel, the muzzle received a shock. To my knowledge no trials were ever made with this gun, but some experiments were made in England in firing under water in 1864, the pieces employed being an Armstrong 110-pounder breech-loading gun of 7-inch diameter, and a Whitworth 24-pounder of 4.37-inch diameter. They were mounted in battery in such a position that at high tide they were covered to a depth of over 6 feet. The charge was kept dry by a linen wad forced into the muzzle, and was always very heavy. The *Excellent*, a condemned vessel, whose sides were about 16 inches in thickness, was used as a target. This thickness of wood was easily perforated at a distance not over 33 feet, and the bursting of the shell nearly always made a hole of over 3 feet in diameter. It was remarked during these experiments that the projectile was frequently subject to great deviations. The velocity of the projectile was, however, said to have been much greater than would have been expected.

Experiments in England show that at a depression of 5° to 7° a shot may be made to enter water and penetrate a target without any ricochet. Of several that are recorded those tried with the Whitworth gun have produced the best results. The best results from experiments made in 1857 and 1858 are as follows:

1857. Rifled 24-pounder: Charge, 2½ pounds; shell, flat-headed; depression, 6° 45′; target, 8 inches thick, 100 feet distant; shell entered water 21 feet from target, pierced target and fell in mud 20 feet beyond; total range through water, 41 feet.

1858. Same gun, same charge, same shell, depression, 5° 30′; height above water-level, 6 feet 6 inches; fired at old hulk; shell entered water 13 feet from ship, penetrated 13 inches of oak at two feet below water-line.

No experiments with submarine guns seem as yet to have

been made on a large enough scale to draw any decided conclusions, but it seems probable that remarkable results may be obtained if the right method of experimenting be adopted. This method would appear to be in the direction of a proper projectile, to which the gun must conform, especially since vessels now carry a torpedo which is to be exploded at the end of a spar, and a logical method of procedure is to endeavor to obtain a projectile of sufficient capacity which can be safely and accurately thrown to the same spot with velocity enough to effect its explosion by contact, and when we have accomplished thus much to then direct attention, if deemed desirable, to extreme ranges, great initial velocities, etc. Apparently an important requisite and one which, so far as I know, has been neglected, is to have the projectile of the same weight as an equal bulk of water, and its centre of gravity coincident with the centre of figure. Another requisite is to have the projectile of large diameter and great proportionate length, with considerable taper at the extremities, and the third requisite is to oblige the projectile to rotate in the water. The reasons for recommending such a projectile are that theoretically it eliminates by its conditions of weight, shape, position of centre of gravity, etc., all sources of deviation in flight, and it will take up its motion under a slighter propulsive force than any other.

The principal problem to be solved is, whether its momentum will give it sufficient range and velocity to make it practically useful. This is evidently dependent upon its weight, and it is plain that a large diameter is essential. For primary experiments, the Whitworth plan of rifling would probably be most advantageous ; but if the ordinary land and groove system were most available, the ribs on the projectile must be small and numerous, so as to afford sufficient surface for the action of the water in keeping up the rotary motion imparted to the projectile by the gun. In either case, since the projectile is so light comparatively, a small charge of slow powder will probably be used, and the twist of the rifling must be very rapid.

A projectile which corresponds to the ideas here advanced is composed largely of wood, carrying the charge in the forward end, in a separate shell, that can be secured by a through bolt or other convenient means. The ribs are to be of metal let into the wood, and for preliminary experiments the entire projectile can be made of some wood, a very little lighter than water, so that the metallic ribs when let in will bring the weight about equal to the displacement. Undoubtedly, any form of rifling will occasion considerable loss to the projectile from friction in the water, as well as increasing the necessary weight and cost of the gun, and experiment should be made with projectiles of this description without ribs, with reference to determining whether they cannot be made to take up a rotary motion by the action of the water above, either by diagonal holes through the head, by grooves on the surface, or other plausible means. By experimenting with the form of projectile here proposed, it is believed that an effective substitute for a spar torpedo can be developed, and one which can be discharged by means of a small charge of powder, from a light breech-loading firing tube, that can be mounted in battery below the water-line on board of almost any vessel.

The plan here proposed differs radically from that of Mr. Woodbury. In the one case the projectile is large and light, and is to be pushed through the water by a moderate charge of slow-burning powder ; in the other it is long, sharp, and heavy, and is to be driven by a large charge of powder through as long an air space as possible before reaching the water. With the former light weight of projectile it would appear that a greater range may be obtained if the shell be pushed through a dense mass of water in which it already lies, than if it were pushed into it from an air space ; consequently the water can be allowed to enter the gun freely (the cartridge being water-tight) and since the charge is small and slow burning, the effect of its ignition is to push from the bore a mass of water of which the shell may be considered as forming a part, the gun being, of

course, long enough to concentrate the gradually accumulating energy of the charge into a prolonged effort. In the latter case it is evident that it will be beneficial to the range of the heavy shot to allow it to store up momentum in an air space, and with the heavy charge used, the strain on the gun must be relieved as quickly as possible by giving the gas the length of the bore to expand in immediately.

It is, of course, probable that by the latter method a projectile can be made to penetrate water to a distance that we cannot estimate from lack of sufficient experiment; but, the projectile being heavy, the question of gravity comes in for serious consideration as regards its accuracy, and, the medium being much more dense than air, the field for experimental research in this direction is very large.

A careful examination of the details of Captain Ericsson's submarine gun and projectile, and of his extended series of experiments, will point out how well the results have proved the statements and predictions of Lieutenant-Commander Barber, U. S. N., made ten years ago. Captain Ericsson is able to present to-day, as the product of his study, application, and mechanical skill, a type of weapon for submarine warfare well to the front in torpedo experiments.

Although the application for the patents for this gun was not filed until 1881, the subject received his careful attention for many years.

In September, 1854, (see the *Century* for December, 1885, pages 296, 298,) he sent to the Emperor Napoleon III. plans of an iron-clad steam battery, which was provided with a cylindrical tube for ex-

pelling submarine projectiles, charged with explosives, for destroying ships by piercing the lower part of their hulls, below the practical limit of armor-plating.

The Emperor promptly acknowledged the receipt of the plans, through General Favé, who said in his letter: "L'Empereur a examiné lui-mème avec le plus grand soin le nouveau système d'attaque navale que vous lui avez communiqué. S. M. me charge d'avoir l'honneur de vous informer qu'elle a trouvé vos idées très ingénieuses et dignes du nom célèbre de leur auteur." Captain Ericsson has reason for supposing that these plans, or copies of them, reached the English Admiralty soon after.

In 1870 he addressed the Navy Department, and presented plans to the naval committee, relating to the construction of a movable, subaqueous torpedo, controlled by a tubular cable, and propelled by compressed air. In 1872 he published propositions to employ two screws, moving in opposite directions, to decrease the errors of direction, and continued his experiments until 1875, when all the apparatus was sent to the naval torpedo station, Newport, R. I., of a submerged, movable torpedo, propelled and steered by compressed air. Not satisfied, however, with these results, he continued his investigations, and in 1877 presented another model, for which he claimed increased speed, improved diving apparatus, and simplicity. After a

series of experiments with it, Captain Ericsson requested that the torpedo be returned to him.

The result of his persistent study is to-day presented in the *Destroyer*.

While industriously developing his conceptions, the importance of submarine artillery was brought to the attention of the British Admiralty by James A. Longridge, the advocate and ablest English theorist of wire-gun construction, who, in December, 1866, submitted to the Chief Constructor of the Navy the detailed plans of a vessel, apparently the foundation of the designs for the *Polyphemus*, which have been generally accredited to Sir George Sartorius. The vital differences appear to be the substitution of the Whitehead torpedo (a subsequent invention) for Mr. Longridge's proposed submarine gun, the absence of a comfortable living place for the crew in times of peace, and the introduction of other changes that will probably not be duplicated in the two new *Polyphemuscs* about to be laid down.

In his paper on "A Monitor for Coast and Harbor Defence, and on Submarine Artillery," read before the Institute of Naval Architects, April 3, 1868, Mr. Longridge said:

* * * * * * *

There can be no doubt that wrought iron will henceforth play a very important part in defensive structures, whether on land or afloat, and the extensive experiments which have been made within the last few years have afforded data from which the engineer can pretty accurately determine the nature of the *structure* requisite to resist any assumed power of attack.

The effects of various kinds of backing have also been ascertained, and making use of such data, the engineer can design, with some confidence, the protection requisite to resist any given attack. The increasing power of modern artillery has called for increased thickness in armor plating, and whilst a few years ago a 4½-inch plate was justly considered a marvel of skill, we have now arrived at the manufacture of plates of excellent quality of no less than fifteen inches in thickness. But the power of artillery is still, I believe, in its infancy, and I am satisfied that we are very far from having attained its limit, and that guns will be produced which will pierce the fifteen-inch plates as easily as the guns of the present day the plates of three or four years ago.

Land defences seem to have this advantage, that there is no limit to the thickness of iron plating; whilst, with ships, the enormous size which would be required to carry plates of such thickness must soon bring their construction, according to the present type, to a practical limit. But the question is worthy of consideration, whether by a modified system of construction we may not give a greatly increased power both of attack and resistance to ships of war. This has been carried out in one direction by the American monitor system, and in another by Captain Cole's turret system of construction. Both of them have been so fully discussed that I will not waste the time of this meeting by offering any remarks on either, but will at once proceed to offer for consideration a design which appears to me to possess considerable advantage. The design is based upon two principles, the first being that of oblique surfaces opposed to the shot for defence; the second that of submarine artillery for attack. Before proceeding further, allow me distinctly to disclaim any credit for the *invention* of these principles. I desire only to lay before the Institution what I think to be practical methods for their application, and, having done so, leave these methods to the consideration of those whose professional experience renders them always the fit judges of such questions.

It is obvious that, by so arranging the armor plating that the angle at which the shot strikes shall be small, a very great resisting power may be given to a plate of moderate thickness. This is what is attempted in the designs before you. One is the design of a monitor for harbor defence. * * *

From the arrangement of the armor plating it may be seen that at, or above the water line, it could only be struck at an oblique angle, even supposing that the line of fire was at right angles to the line of keel. If the maximum angle of depression of an antagonist were 15°, the projectile striking it at the water-line would strike at an angle of 60°. * * * But, in point of fact, such a vessel should never be exposed to such a fire. Being provided with twin screws, or with hydraulic propeller for steering, the vessel would always be kept head-on to his opponent, so that the fire would be received nearly in the line of keel.

* * * The object of the monitor would be to go straight into close quarters ; in fact, not to fire a gun until her bow was in contact with the hull of the enemy. At the moment of contact she would fire her bow gun, which would put an elongated 9-inch shell into her opponent at a depth of 10 feet below the water-line, and consequently beneath her armor plating. Having done this, she would, by means of her twin screws or hydraulic propeller, pivot round and fire her broadside guns at the same depth below the water-line. She might then drop astern, and, ranging up on the other side of her opponent, deliver the other broadside, which would probably be quite sufficient to decide the contest.

There can, I think, be no doubt as to the result of such a conflict, if the monitor can get alongside. The question then is, can she do so with impunity to herself ? What is to prevent her ? In the first place, she is impenetrable to the fire of her adversary ; then she has far superior steering powers, and could at all times keep one end in position ; then again, she would have great speed, because, not being a sea-going vessel, she

could carry fuel enough to supply enormously powerful engines for the short time she would require to be under steam.

It may be said that the attacking vessel would ram the monitor. No doubt she would if she could catch her, but it seems to me quite impossible that a large vessel with inferior manœuvring powers could do so. Besides, the enemy would not have one, but three or four, of such small opponents to deal with, and it seems to me impossible that she could escape. Her only safety would be in running away, if she had superior speed, and this is exactly what is required in harbor defence.

In the drawings before you, a light upper deck and deck houses are shown, as also an inclined conning shield. When the object was simply harbor defence, as for instance, at Spithead, or for the Thames, I would abandon these, and the funnel might also be abolished in favor of horizontal apertures, voiding the products of combustion at the stern under the quarters, the draft and ventilation being provided by fans.

The other design represents the same system applied to a sea-going vessel, carrying, besides five submarine guns, two turrets, and deck accommodation for the crew. The vessel would have length between perpendiculars two hundred and forty feet ; breadth, extreme, forty feet.

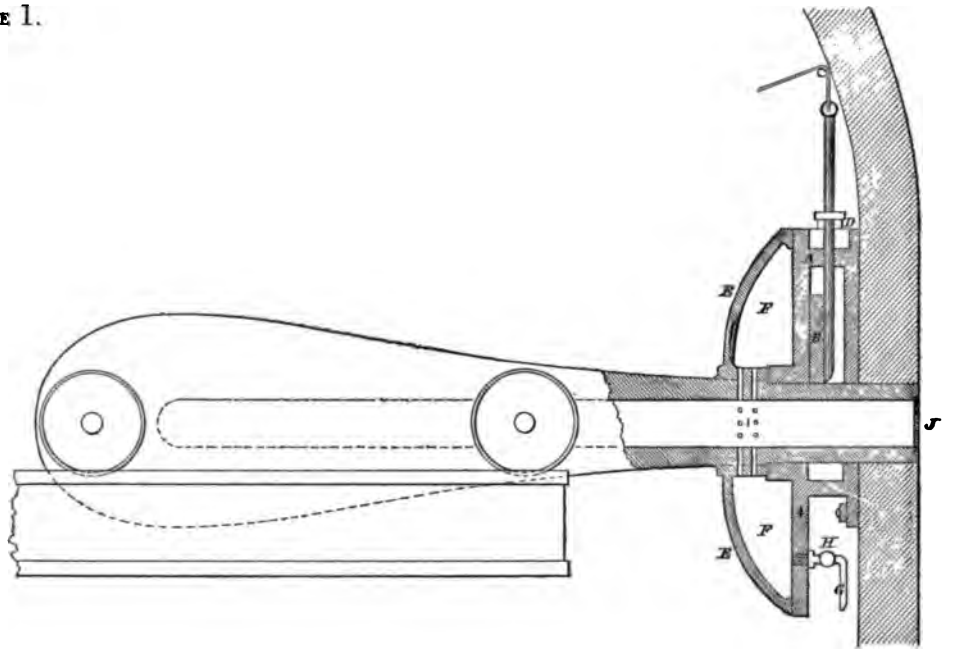
* * * * * * *

The construction of the guns and the system of working them may be thus described.

The gun has no trunnions, properly so-called, but is mounted on four wheels, which run on a railway laid in the line of keel for the bow gun, and at right angles for the broadside guns. There are proper compressors for regulating the recoil. The muzzle of the gun passes through a valve chest A, fixed to the stem or side of the vessel. This chest contains a slide valve B, the rod of which passes through a stuffing-box, D.

The outside of the valve chest carries a circular face, which is faced truly to fit the surfaces of the disc, or cup E, which is fixed to the gun. Thus, when the gun is run out, there is a cir-

PLATE 1.



cular air-chamber, F, between the air-chest and the disc. A pipe, G, fitted with a stop-cock or valve, H, communicates between the space, F, and another chamber in which a vacuum is kept up by the engines of the vessel, or by a small donkey-engine.

As soon as the gun is run out, and the surfaces of the disc E and the valve chest are in contact, the valve H is opened, and a partial vacuum formed in F, and also in the chase of the gun which communicates with the space F by holes at I. The gun is thus held firmly to its place without any lashings. Instead, however, of this apparatus, a breech strap with breaking bolts might be applied. As soon as the gun is loaded, a disc of thin wrought iron, J, with an india-rubber ring, is placed in a recess in the muzzle. The gun is then run out, the valve B having been raised, and the cock or valve H opened, and the vacuum established in the inside of the gun and the space F, whereby the gun is held fast with a force proportional to the extent of vacuum and the area of the disc E.

Immediately before firing, the valve H is shut; but as soon as the gun is fired, the gases which pass by the windage enter the space F, and destroy the vacuum, and the gun is free to recoil, which it does. As soon as the muzzle passes B, the valve drops and prevents any water entering the vessel. The gun is then reloaded, and run out ready for firing as before.

When the London *Engineering*, of July 8, 1881, published illustrations of the construction of the *Polyphemus*, Mr. Longridge sent the following letter to the editor, and it was published in the issue of July 28, 1881:

TO THE EDITOR OF *Engineering*:

SIR:—In your issue of the 8th of July you gave illustrations of the construction of the *Polyphemus* which at once attracted my attention. In an article in the *Standard* of 15th June I had previously learned something about this vessel, *inter alia*, that

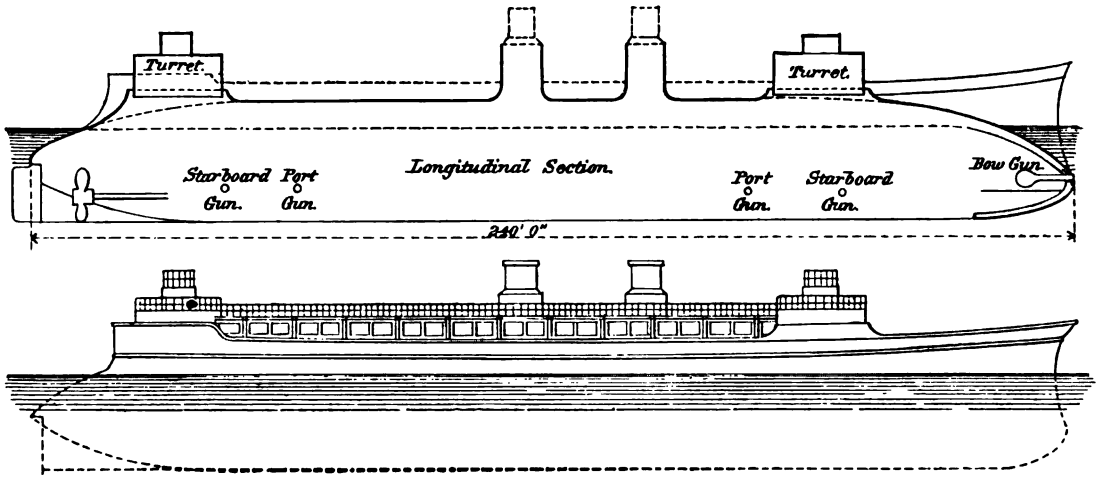
her design was described to the House of Commons by the late Mr. Ward Hunt in March, 1877, who then gave the credit of the idea to Sir George Sartorius, adding, however, that "we [the writer of the article] believe the gallant admiral is not disposed to recognize the *Polyphemus* as a true embodiment of his ideas."

I have no wish to detract from any credit which may be due to Sir George Sartorius or any one else, but I beg to say that the leading idea of this vessel is mine, and that I submitted it to the Chief Constructor of the Navy in December, 1866, and that it was favorably reported on and recommended for serious consideration.

From that day to this I heard no more about it, although in April, 1868, I read a paper before the Institution of Naval Architects (published in vol. ix. of the "Transactions").

I send herewith a copy on a reduced scale of the design which I have above mentioned, and I think it fully justifies my assertion that the leading idea of the design of the *Polyphemus* is the same as mine. (Plate 2.)

It is true that in the *Polyphemus* torpedoes are intended to be used, whereas in my design submarine artillery was the offensive weapon, but the essential feature of the design is what is called the turtle-back deck. In my paper read before the Naval Architects in 1868, I said: "The design is based upon two principles, the first being that of oblique surfaces opposed to shot for defence, the second that of submarine artillery." So far as I know, I was the first to apply these principles to the construction of a ship-of-war. Whether my design, as submitted to the Admiralty in 1866, was better or worse than that now adopted in the *Polyphemus*, it is not for me to say. I will, however, point out two points in which, in my judgment, my design is preferable. First, it is a very powerful turret ship as well as a submarine battery. It has two turrets capable of carrying very heavy guns. The *Polyphemus* carries only torpedoes and small Nordenfelt guns. Second,


Turret.
Turret.
Starboard Gun.
Port Gun.
Longitudinal Section.
Port Gun.
Starboard Gun.
Bow Gun.
240' 0"

my design affords excellent accommodation for officers and crew, and a spacious deck. In the *Polyphemus* such accommodation as there is is below the turtle-back. There the crew and officers are to live in an artificial atmosphere and by artificial light. As you say in your article of July 8th: "The 103 men who form the crew may manage to live in the limited spaces allotted them forward on the main deck, but they will be barely comfortable, notwithstanding the elaborate ventilators both for conveying in fresh air and for removing foul air which pass along overhead and considerably limit the area over which it is possible to stand upright. The officers also will fare but little better in their quarters on the main deck aft; their accommodation is not luxurious. The round turtle-back form of the upper deck indicated on the midship section is preserved forward and aft; indeed it is sharper toward the extremities, so that out towards the sides of the living deck, both forward and aft, it will be impossible to stand upright."

It is difficult to imagine any thing more horrible than a cruise in such a vessel, and certainly the comfort, health, and happiness of our gallant seamen are no unimportant matters. It is quite true that in my design the above-deck accommodation would be considerably damaged in *action;* but what of that. If it were clean shot away, or smashed to pieces, the ship would still be at any rate *as comfortable* as the *Polyphemus* in her normal state, and after the action damages could be very easily and speedily repaired.

I will not enter into the question as between torpedoes and submarine guns. I think the latter are preferable if you can get alongside your enemy. They are far safer, far less expensive, and equally effective.

In the discussion which took place on the 3d of April, 1868, at the Institution of Naval Architects on Admiral Halsted's paper, which was read immediately after mine, remarks were made about the great length of the turret ships proposed by him.

Mr. Barnaby said : " *We may suppose that to use the principle proposed (by Admiral Halsted) we shall probably get ships* 500 *feet or* 600 *feet long. Now I can imagine that an enemy who had the power which Mr. Longridge has been showing us here this morning, and who was able to use it, would like nothing better than that we should spend our money on ships of that kind.*"

I am not going to criticise the details of the *Polyphemus* as ship construction. It would be impertinent in me to do so but there are at least two points which as a mechanician strike me as monstrous : one is the proposed ramhead, as it is called, for closing the bow torpedo port ; the other is the so-called detachable ballast. I think I need not occupy your space nor waste your readers' time in discussing these abortions.

I sent to the Admiralty in 1866 two designs, one for a sea-going monitor, which is the one shown in the sketches sent herewith. It is rather a curious coincidence that the length and breadth of beam of this design were exactly those adopted in the *Polyphemus*, viz., 240 feet and 40 feet respectively.

My ship was proposed to be armed with one bow and four broadside submarine guns, 10 in. or 12 in. calibre, and two turrets 20 ft. to 25 ft. in diameter.

The *Polyphemus* is simply armed with four torpedo ports and Nordenfelt guns in the turrets. The other design which I submitted to the Admiralty was solely for harbor defence, and carried one large submarine gun in the bow only. The following were the proposed dimensions :

	ft.
Length between perpendiculars . . .	180
Breadth, extreme	32
Draught of water	14
Tonnage, B.M., tons	875

Three or four such vessels, which need not have any excessive speed, would, as harbor defences, be more than a match for the heaviest iron-clad afloat, and the cost would be comparatively insignificant. They would be short, handy, and invul-

nerable, and the only safety for the enemy would be excessive speed utilized in running away.

I am, sir, your obedient servant,

J. A. LONGRIDGE.

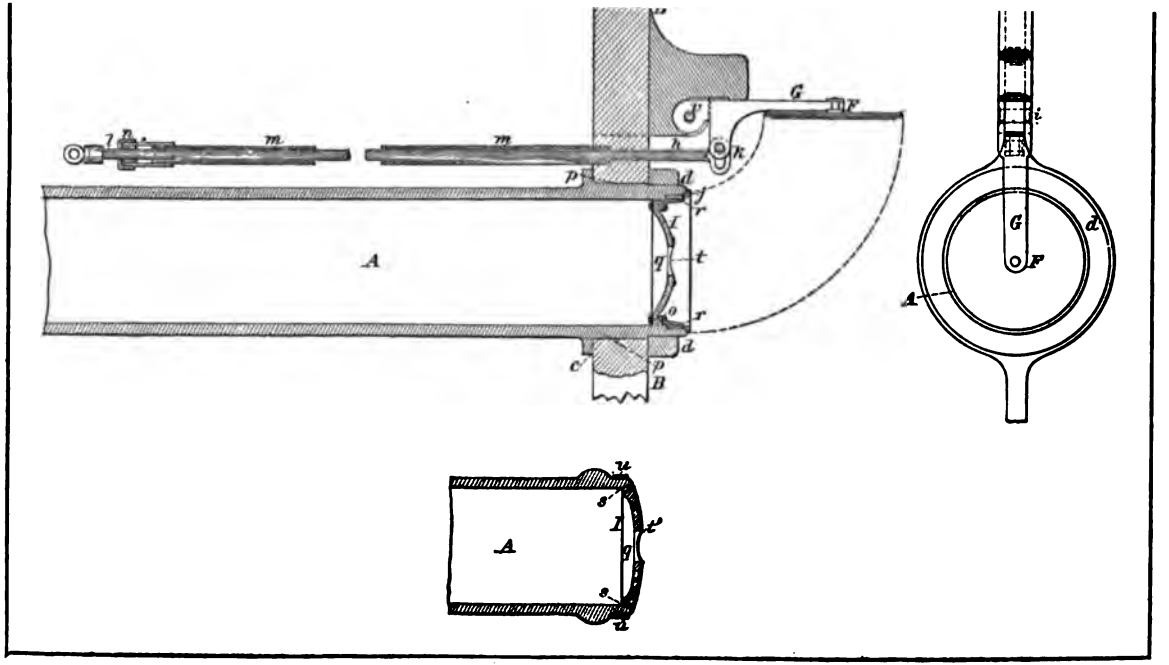
15 Great George Street, Westminster,
July 28, 1851.

The letters patent granted Captain Ericsson the invention of certain new and useful improvements in guns for submarine warfare and their adaptation to ships and other vessels, for improvements in explosive projectiles, and the percussion apparatus for firing the charges of the same.

Between the projectile and its projecting charge is a piston, which is fitted gas-tight to the bore. A box or case that contains the projecting charge of powder is of a diameter much smaller than the bore of the gun, and is attached to the piston by a supporting wooden rod, the case and its charge occupying but a small portion of the space left in the chamber of the gun between the piston and the breech.

To the muzzle of a gun for firing under water, a frangible valve is secured, which serves to exclude water from the bore of the gun before the discharge of the projectile, but which is destroyed by the projectile during the discharge.

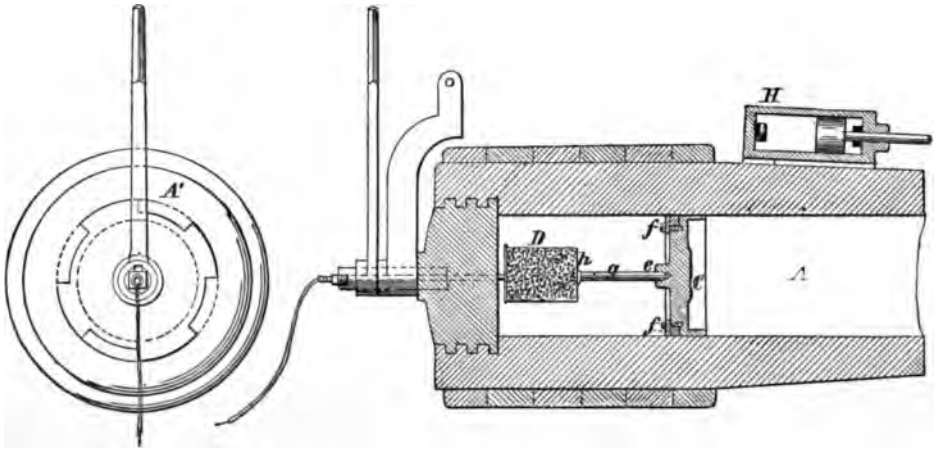
Frontispiece is a longitudinal central sectional view of a torpedo vessel having an Ericsson submarine gun fitted to its bow. The smooth-bore gun A, of iron


m
m
G
F
d'
h
k
p
d
f
r
A
q
t
o
x
d
c'
p
B
u
s'
t'
s
u
G
F
d
A

or steel, is made of flanged sections, with flanges, *a a*. The breech rests on a bed, *b*, on the keelson. The muzzle is fitted into an opening, *p*, provided for it in the stem B, with a shoulder, *c*, inside, and is secured by a nut, *d*, screwed on it outside. The breech-loading system may be of any suitable kind.

Plate 3 is a section of the forward portion of the gun, showing the stem of the vessel, the temporary and permanent muzzle valves, the means of working the permanent valve, and the method of attaching the temporary valve to a muzzle-loading gun.

Plate 4 is the breech portion of the gun showing the piston, the attached powder case, and the rear view of the breech. C is the metal piston, fitted with metallic packing *f* of any suitable kind—such, for instance, as is used in steam-engine pistons. This piston is fitted to work in the smooth bore of the gun A like the piston works in the cylinder of a steam-engine. It is made with a central socket, *e*, in its back for the reception of the supporting-rod *g*, to which the powder case D is attached. This case, which may be made of tin-plate and cylindrical, has a central socket, *h*, for the reception of the rod *g*. When placed in the gun its rear end is covered with a piece of netting that serves to prevent the powder from falling out, but through which the fire from the fuze can reach the whole of the rear surface of the charge. By this method of applying the powder case in the gun adequate space is provided for


A'
H
D
f
h
g
e
f
A
f

the gas expansion, and injurious pressure on the gun is avoided. The projectile E occupies nearly the whole length of the bore of the gun in front of the piston C.

F is the permanent valve for keeping the muzzle of the gun closed before and during the loading. This valve is attached to an elbow-lever, G, which is hinged to the stem by pivot joint, *i*, above the projecting muzzle. It may be faced with an india-rubber gasket, or otherwise fitted to the seat *j* provided for it. This seat consists of a separate ring of brass or gun metal fitted to the muzzle. The elbow-lever G is connected at *k* with a rod, *l*, that passes through a hole in the stem, and through a tube, *m*, that is screwed into the hole, and fitted at its rear end with a stuffing-box, *n*, in which the rod is packed. This rod may be manipulated by any convenient means for the purpose of working the lever G to open and close the valve, but is connected with a piston operated by steam or hydraulic pressure in a cylinder, H, suitably arranged on board the vessel.

The temporary valve, which is shot away by the projectile, is composed of a wooden disc, I, furnished with a cup-packing, *o*, or packing of leather, india-rubber, or other suitable material, and having a hole, *q*, in its centre, which is closed water-tight by a piece of india-rubber, or other penetrable material, *t*, secured around the margin. It is furnished with three or more catches, which may be variously con-

structed, but which consist of elastic steel hooks, *rr*, secured to its face, and which always exert a tendency to spring outward beyond the circumference of the valve. This valve fits like a piston in the bore of the gun, and is inserted from the breech before the projectile and pushed forward along the bore by a rod until it arrives near the muzzle, when the hooks, *rr*, spring outward after passing a rabbet provided around the interior of the muzzle of the gun or the interior of the permanent valve-seat *j*. The clicking noise made by the springing of these hooks into the rabbet is readily heard through the bore of the gun, indicating that the valve is in place. The hooks retain the valve in place against the pressure of water outside.

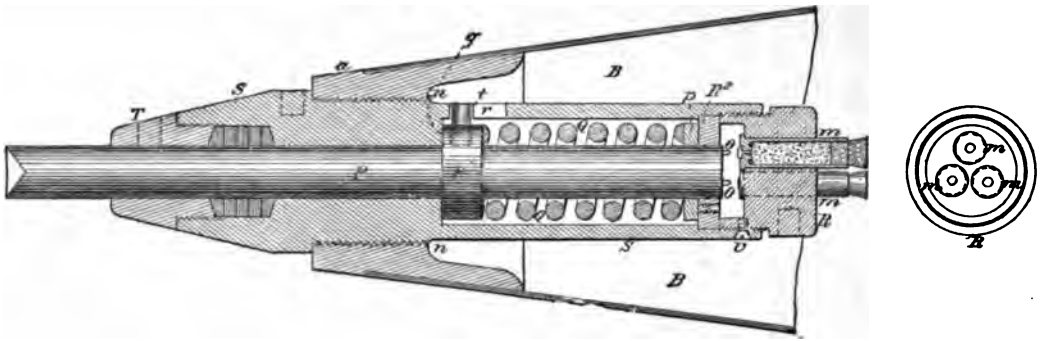
For a muzzle-loading gun the temporary valve is to be applied after loading, the disc, I, being fitted into a seat, *s*, in the muzzle, and secured by a cap, t^1, of india-rubber, which fits over the muzzle, and may be secured thereto by a binding cord, *u*. This cap t^1 also serves as a water-tight covering for closing the central hole *q* of the valve. The valve, which offers very little resistance to pressure from within the gun, will be shot away by the projectile as the latter begins to leave the muzzle, and will generally be broken in pieces. The central portion of it, being of soft material, will offer so little resistance to the firing-pin in the front of the explosive projectile, that there will be no danger of premature explosion of the charge contained therein.

The vessel, or floating gun-carriage, is constructed with two decks, JJ', separated by about three feet, the space to be filled with floats, composed of cork or bags of india-rubber or other material inflated with air. The vessel is intended to be immersed to such depth that the lower deck J' will be below the water line, and the portion of the vessel below it will be protected in a great degree from the enemy's shot by the surrounding water. In case the upper deck J, or any part of the vessel above it, is penetrated by shot, such of the floats between the two decks as are not destroyed will continue to give buoyancy to the vessel.

Across the vessel above the decks, in front of the pilot-house M and in front of the base of the smoke-stack, is a shield, K, composed of very heavy armor-plates inclined upward and backward in such manner as to deflect any shot or other projectiles that may strike it. This shield has a backing of solid timber, L, that would enable it to resist shot which might strike it at, or nearly at, a right angle.

Plate 5 is a central longitudinal section of the percussion apparatus and of a part of the head of a torpedo to which it is applied, including the front view of the plug that closes the rear end of the socket of the apparatus, and which receives the primers by which the charge is ignited. S is a socket that contains all the parts of the percussion apparatus, and which is screwed at *n* into the head *a* of the projec-

PLATE 5.



PROJECTILE HEAD AND PERCUSSION APPARATUS.—ERICSSON'S SUBMARINE PROJECTILE.

tile entering the chamber B, which contains the explosive charge. P is the firing-pin, centrally placed within the socket S, and protruding from the front thereof. Q is a very strong coiled spring arranged around the firing-pin. R is a plug screwed into the rear of the socket and having in it two or more holes to receive fulminate primers or cartridges, *mm*. This plug is secured against turning in the socket by a screw, *r*, passing through the socket and screwed into the plug, securing the primers in certain positions.

The firing-pin is straight, and provided with a collar or shoulder, P′, at some distance from its rear end. Its front end is made with a chisel-point or other sharp edge, to prevent it from glancing off from a vessel which it strikes. Its rear end is furnished with two or more points, *oo*, to strike the primers *mm*. The socket S is bored centrally, and has in its front end a stuffing-box, T, through which the firing-pin works water-tight. The bore is enlarged some distance behind the stuffing-box, sufficiently to receive the collar P′ and the spring Q, the spring and pin being inserted into the socket from the rear before the plug R is put in. In front of this plug there is a collar R′, which is held by the plug against a shoulder, *p*, formed by a further enlargement of the bore behind the portion which receives the spring. This collar serves as a guide for the rear end of the firing-pin, and as an abutment for

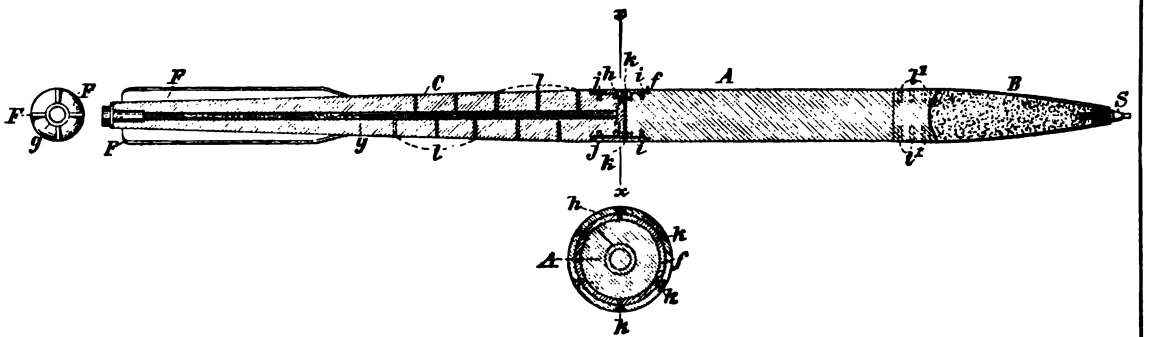
the spring, which is powerfully compressed between the collar R′ and the collar P′ on the firing-pin, and holds the latter so securely against a shoulder, *p*, that no possible accidental concussion on the front end of the firing-pin could drive back the pin in the socket.

The points *oo* on the rear end of the firing-pin, and the primers *mm*, correspond in number and position, and in order to preserve the proper positions of the points relatively to the primers, and so insure each of the points striking properly one of the primers when the firing-pin is driven back into the socket S, there is a longitudinal slo', *r*, in the socket in which fits a pin, *t*, that is screwed into a tapped hole in the collar P′ and projects laterally from the firing-pin. When the collar P′ is held against the shoulder *p*, the points *oo* are some distance from the primers. These primers may resemble the metallic cartridges commonly used for small-arms, and be either "centre-fire" or "rim-fire." The firing-pin being kept from turning by the pin *t*, and the plug R being kept from turning by the screw *v*, the striking of all the primers is insured, and the firing of the explosive charge in the projectile cannot fail from the missing fire of the primers *m*, unless the whole number should miss, and it is hardly within the range of possibility that all should miss when the front end of the firing-pin strikes a vessel or other body attacked with the impact due to the momentum of the projectile.

The projectile has a wooden body and tail, capable of resisting the crushing pressure applied to project it from the gun. Plate 6 is a central longitudinal section of the subaqueous projectile torpedo, together with a rear end view and a transverse section. The form of the projectile is cylindrical at and near its centre of displacement, and conical in front and rear thereof, the conical profile of the front part or head B presenting a greater, and the conical profile of the rear part or tail C a lesser, angle to the axis, providing for a capacious powder-chamber in the head for the exploding charge, and producing an elongated tail. On the tail are four radial and longitudinal steadying wings or fins, FF. The centre of displacement is intended to be forward of the middle of its length, and the weight of the projectile, when charged and ready for use, should be nearly equal to, but not greater than, the volume of water it displaces.

The cylindrical portion A of the body is made of a solid piece of wood, with a band, *f*, of iron firmly secured to its rear by screws, *ii*. The tail-piece C is also made of wood, and is solid, except that it is bored centrally for the reception of an iron rod, *g*, that fits it tightly and runs through its entire length, with a head at its rear end. The front of the tail-piece has firmly secured to it by screws, *jj*, a flanged abutment piece, *h*, that receives the rear portion, the ring, *f*, and is secured thereto by screws, *kk*. The

Plate 6.



rod *g* abuts against the plate forming the front of the socket *h*, and it is secured in the wood by iron pins, *ll*, transversely through the wood of the tail-piece, and entering holes in the rod. The pins FF are also of wood, having the edges faced with plates of iron or steel. The powder-chamber B fits over the front of the wooden body A, and is secured thereto by screws *l'l'*. This construction gives the wooden body and tail-piece all the strength and support necessary to enable them to resist the impact of the explosive force of the charge of powder employed to discharge the projectile from the gun.

To obtain practical and full results with the submarine gun and its projectile torpedo, it was necessary to provide a suitable floating carriage of high speed and handiness, and with such equipment as would facilitate the most thorough experiments to demonstrate the advantages and usefulness of the system.

These elements obtain in the *Destroyer;* and while she may not equal in construction, speed, capacity, and general efficiency the most advanced types of torpedo-boats abroad, or in other words a perfected torpedo-vessel, she is excellently well adapted to exhibit the merits of the system.

Congress has already been supplied with much information relating to the torpedo machinery of the *Destroyer*, but a *résumé* of the investigations and experiments will be useful, and may assist to remove some wrong impressions that are known to exist.

In November, 1881, the owners submitted a request to the Navy Department for an examination, by a board of naval officers, of the system of torpedo attack as developed in the Ericsson torpedo-boat *Destroyer*. This request was granted, the *Destroyer* was removed to the Navy Yard, Brooklyn, N. Y., and her owners were notified of the date of the meeting of the Board, with the suggestion that —

> You have all necessary appliances, fuel, targets, etc., in readiness, so that the Board may give a full trial of her speed and efficiency and power without unnecessary delay. She should be tested at her service-draught water.

The owners replied :

> We shall be ready and glad to afford every opportunity to the Board to ascertain the peculiarities and to carry out any experiments they may require to give them a complete understanding of all parts of the torpedo machinery.

In December, 1881, a board composed of three naval officers was appointed and furnished by the Chief of the Bureau of Naval Ordnance with special points of inquiry pertinent to the proper examination and test of a vessel presented as a complete engine of war for torpedo attack and defence.

The owners claimed :

> (1) The main principle of the patented submarine gun and projectile torpedo is that of attacking an adversary at such a distance that a quantity of explosive matter necessary to insure

complete destruction may be employed without injury to the vessel carrying the submarine gun.

(2) Various trials carried out by European maritime powers have shown that the sphere of action of certain modern explosives is very considerable. The designer of the projectile torpedo of the *Destroyer* has therefore conducted a series of experiments for the purpose of ascertaining practically if this weapon can be projected with such a velocity as to admit of its explosive charge being fired at a distance which places the attacking vessel completely out of harm's way, and yet near enough to insure hitting the mark and preventing the adversary's escape.

Compressed air, although powerful enough to expel the Whitehead torpedo, being altogether too feeble for imparting the high velocity needed under the before-named conditions, gunpowder is employed as the propelling power of the projectile torpedo of the *Destroyer*.

(3) During repeated trials conducted on the Hudson, a charge of twelve pounds of powder has been found sufficient to impart a very considerable initial velocity to the projectile, the first three hundred feet being invariably traversed in less than *three* seconds.

(4) It merits special notice that the insuperable difficulty hitherto experienced in "shooting under water" has been overcome by the peculiar form and proportions of the projectile torpedo. The employment of a sufficiently heavy charge of powder to attain the desired velocity, irrespective of form and proportions, is inadmissible, since the resulting force would crush the tail-end of the weapon. Numerous trials conducted during two succeeding seasons, show that weight, form, and dimensions must bear a certain fixed relation to each other, otherwise the distance of 300 feet cannot be traversed in three seconds. It will be proper to add that the fixed relations thus called for have been definitely settled by the experiments referred to, and that the submarine gun and projectile torpedo applied to the *Destroyer* have been built accordingly.

(5) No drawings were presented of the hull or steam machinery of the *Destroyer*, as the designer of her gun and torpedo had neither applied for nor obtained patents for the vessel or its motive power. Any craft of suitable form and sufficient draught of water for the due immersion of the submarine gun, will answer equally well as regards the operation of the torpedo machinery. By the simple expedient of building a breastwork across the vessel near the bow, composed of inclined heavy steel plates supported by a deep wooden backing, as in the *Destroyer*, any iron-clad ship may be attacked, bows-on, without fear of injury to the motive engines or torpedo machinery.

As the instructions to the Board required a steam trial, and, when under full speed, the firing of the submarine gun, a request for such trials was made, but declined by the owners for the reason that "individuals are not permitted to perform work on their own responsibility connected with implements of war, which, in case of accident, involves loss of human life."

This prevented so thorough a test as could have been made under government control; furthermore, the basin in which the trials took place was too shallow. Although the report was unfavorable, the Board reported that:

(1) The gun was as simple as any other breech-loader.

(2) Further and prolonged trials should be made to determine the ability of the gun to stand with safety the powder pressure.

(3) The torpedo has the necessary strength.

(4) It surpasses in simplicity any other known form.

(5) Little or no liability of derangement or injury while being handled.

(6) Smaller than other movable torpedoes containing an equal charge of explosives.

(7) From its size and shape it would pierce any of the ordinary forms of torpedo defence.

(8) The mode of igniting the propelling charge was satisfactory.

And concluded that:

Though the trials before the Board have been very limited, sufficient has been shown to convince them that the Ericsson submarine torpedo is a projectile of the most formidable character within a limited range; and within that range, whatever further experiments and improvements may prove such to be, it is superior to any of the known forms of torpedo.

On account of the constant interruptions to which trials of this character are exposed in this vicinity, the Board would suggest (the owners consenting) that the *Destroyer* be sent to Newport or some other point suitable for a more extended trial.

These experiments having demonstrated that the efficiency of the submarine gun would be increased by the application of some gear to turn the vessel on its vertical axis, Captain Ericsson introduced a new screw-propeller in the dead-wood. The results were satisfactory and the accuracy was improved.

No proposition by the owners being acceptable to the Department, in January, 1883, the inventor took the entire matter into his own hands, and decided to prepare the *Destroyer* for a trial at sea, furnished with service torpedoes, floating targets, and all necessary working gear. These improvements were made, and Captain Ericsson has been assured by a series of experiments extending over a period of *four months*, that:

(1) No deviation from the axial line of the gun occurs while the projectile is passing out of the bore, the four metallic rings which form guides to insure parallelism, and the extremely minute period of time for the expulsion of the projectile, preventing such deviation.

(2) The projectile continues its course in the direction of the axis of the gun at the instant it leaves the bore.

(3) Less accuracy of aim is requisite than with the ordinary gun, because of the short range at which the gun is to be used, an error of 1° causing a deviation of but 5 feet in the range of 300.

(4) The outboard sea-valve works efficiently with the vessel running at full speed, and the inner valve showed itself capable of resisting the united pressure of the sea and the current attending maximum speed.

(5) The propelling piston performed satisfactorily, and a gas-check has been fitted.

(6) The firing-pin showed itself capable [redacted]

ERRATUM.

The increased beam of the *Destroyer* has imparted great ty and buoyancy, enabling her to carry at sea inclined 2 *feet* thick with 5 *feet* of wooden backing.

or a steel vessel of the *Destroyer* type, and stated hat he was prepared to enter into an agreement, nder guaranty, to deliver the vessel complete and eady for service within twelve months from the date f the receipt of the contract.

Frontispiece is a longitudinal section of the bow of such a vessel.

The history just recited will show the extended and serious attention Captain Ericsson has given to the subject of torpedo warfare and the very satisfactory and important results he has obtained.

When we consider the amount of money other nations have spent for torpedo experiments, and the fact that the inventor is prepared to guarantee the due performance of the submarine gun and projectile (as he did in the case of the *Monitor*), it would seem a most reasonable request to ask Congress to appropriate an amount sufficient to purchase the *Destroyer* and to make trials with the torpedo-boat in which Captain Ericsson's experiments have been so successfully conducted and by which his system has been so well developed.

The amounts that have been expended by the various governments for the development of the Whitehead torpedo are enormous, but they are insignificant if the governments feel a sense of security in the possession of an efficient system of torpedo defence.

England alone has spent hundreds of thousands of pounds experimenting with this torpedo and the means of carrying and discharging it. Her Majesty's ship *Polyphemus* has been conspicuous in absorbing the lion's share of these expenditures. In August, 1883, the London *Times* published the following:

The country will learn with satisfaction that the *Polyphemus* screw ram, which is purely an exceptional ship as regards her form, armament, machinery, ventilation, and the power of her engines in relation to displacement, is likely at the eleventh hour to prove a success. This was at one time considered very doubtful, and many breakdowns were recorded. She was brought round from Chatham at the beginning of the year, since which time she has been put through constant experiments, with the object of rectifying admitted and notorious structural weaknesses and defects in her under-water torpedo gear. Her preliminary trials at the Nore and her seaworthiness during the voyage to Portsmouth justified the Admiralty in running to the additional expense of replacing her original locomotive boilers by a set of ordinary marine type. But while her success as a ram, for which she was exclusively designed, was thus shown to be certain, great apprehensions existed with respect to her torpedo arrangements. The *Polyphemus* is intended to carry no guns, and hence with impracticable torpedo apparatus she would be dependent in action upon her ram alone.

The mechanism for ejecting the Whitehead torpedo does not greatly differ from that adopted in the *Vesuvius* and *Inflexible*, and its defective action may be therefore referred to the increased speed of the ram, 17 knots, and the increased immersion of the tubes. One of the tubes is placed in the ram itself, which is made hollow for the purpose, and two are fitted to act on the broadside. The first failed from insufficient initial impulse to force the projectile into the water and away from the ship, while it was found impossible to project torpedoes from the broadside ports, except at very low speeds, in consequence of the tremendous pressure which the torpedo encountered from the water the moment it left the cover of the ship and the excessive vibration of the launching gear. * * * When the speed of the ship attained about 10 knots the projectile was often so tightly nipped by the pressure that it absolutely

refused to move, and it was found impossible to move it without injury to the torpedo or danger to the ship. At other times, * * * the leverage exerted upon the tail * * * was so great as to disable the propeller. Repeated attempts were undertaken with a view of surmounting the difficulty, but without success, and at length the Admiralty, on the principle that a number of heads are better than one, appointed a special committee for the purpose of considering questions relating to the projection of Whitehead torpedoes from submerged tubes.

The *Polyphemus* was laid down in Chatham in September, 1878. Although Commander Gallwey, R. N., in a paper read March 6, 1885, before the Royal United Service Institution on the subject of "The Use of Torpedoes in War," paid high tribute to the Whitehead torpedo as surpassing all others in efficiency, and presented arguments in favor of the much abused *Polyphemus*, according to the London *Times* (May 26, 1885) she has not been until now considered

"to have justified the hopes of her designers, and to have demonstrated her claims to be regarded as a vital addition to the naval defences of the country"; or, after seven years of unlimited expenditure, she has "worked out the torpedo-discharge and boiler questions," and assisted to model other ships; for, "in the two new *Polyphemuses* to be laid down, besides having their offensive powers strengthened by dispensing with the torpedo-discharge through the ram itself, and giving them a small gun armament," other improvements are to be introduced. "They are to be both longer and broader than the existing ram, and greater habitability is to be secured by constructing an ordinary ship above the turtle deck, which will be protected by 3-inch armor."

As the Whitehead torpedo tubes can be fitted to vessels of different types, so may be the Ericsson submarine gun ; and while the *Destroyer*, which is practically a floating gun-carriage, constructed to carry the gun at a suitable depth, does not equal in speed and equipment the torpedo-boats of accepted types, this fact should not take any thing away from the importance of the results that have been obtained with the gun and its projectile, nor materially diminish the value of the system.

The *Destroyer* attacks bows-on, the machinery being reversed at a comparatively safe distance of 300 feet. In pursuing a retreating enemy this distance may be reduced to 200 feet.

Besides presenting too small a target to be hit with any certainty during an engagement, she is protected by armor plates placed transversely at an inclination of 30°, supported by heavy wood backing.

A reflector affords a full view of the horizon in front of the vessel to the helmsman and others who stand behind the armor while governing and guiding the movements of the vessel. They are thus protected from the powerful fire of the modern rapid-firing torpedo-guns.

The *Destroyer* system dispenses with the complicated air-compressor method of the Whitehead and others, powder taking the place of all the intricate mechanism on which they depend.

The rudder is equipoise and formed of a strong steel frame covered with $\frac{3}{16}$-inch plates It is firmly hinged to the rudder-post in such a manner that its top will be at least $3\frac{1}{2}$ feet below the load line. Hydraulic pistons work links that are connected to the tiller-plates riveted on each side to the lower part of the rudder.

In torpedo warfare the greatest danger to be met is to avoid the destruction of the torpedo-boat itself, and at the same time to be sure of the successful explosion of the torpedo. Lieutenant Latour's recent experience in destroying the Chinese flagship at Foo-Chow shows what a comparatively small chance he had of escape. For some time he could not get clear of the Chinamen, and was not only subjected to a galling fire of deliberate aim, but had every reason to fear that he must be carried down with her when she sank. Fortunately for him and his crew of eleven men, his engines (or something else) were strong enough to disengage him from his enemy and by a marvellous chance he lives to enjoy the glory he so bravely earned.

While one may reasonably expect a loss of 50 per cent. of boats and *personnel* in torpedo warfare, and while this may be an economical expenditure in comparison to the enemy's loss, a torpedo-boat commander will be in a superior position if he has a weapon that can be effectively fired at his enemy, and still have 200 or 300 feet for manœuvring.

Captain Ericsson feels confident that he has accomplished this, and the results fully justify him in this belief.

In relation to the cost of boats of this type, the English *Army and Navy Gazette* said that "Mr. Ericsson's invention would revolutionize naval warfare, but financial reasons will prevent its appreciation by various governments." Its contradiction of the statement made by Senator Blair, of New Hampshire, to the effect that the British Government was engaged in negotiations looking to the purchase of Ericsson's submarine gun and projectile torpedo, called forth the statement from Captain Ericsson that—

> As the *Destroyer* has no other artillery than its submarine gun, it would be harmless for attacking sea-board cities, and its possession by the enemies of the United States would be of no importance.

On the other hand, however, a large iron-clad would be able to carry a vessel sufficiently large to fire a similar projectile, which could easily be used against our fleets; while the possession of it by an enemy of the United States would not even have the elements of success which the San Francisco *Post* described as the result of the King of Dahomey's experiments.

> The king received an invoice of Krupp cannon not long ago, and conceived the idea of having them mounted on elephants' backs for use in the field. With much difficulty this project

was carried out, and at the next military review the king ordered that the guns be fired immediately in front of the royal position, first taking the precaution to place a couple of thousand prisoners about where it was calculated the ball would strike, so as to judge of the effectiveness of the shot.

When all was ready, one of the biggest elephants was backed round and sighted. Just as the lanyard was jerked, however, the animal turned half round to reach for a peanut or something, and the shell took off the prime-minister's head and knocked a hole as big as a sewer through the royal palace. His majesty wouldn't have cared so much if the matter had ended there, as the minister's head was very prime, and the palace needed ventilation ; but it didn't. On the contrary, the elephant, which had stood on its head by the recoil, picked itself up in a fury and started on the down grade ahead of its ticket. It upset the grand stand the very first rush, slung the grand chamberlain and past grand carver of missionaries into the next street. It then jumped into the brass band with all four feet, and if it hadn't got the big drum over its head, so that it could n't see, would have cleaned out the entire crowd.

The king was not found until the next morning, and then, as he slid down out of a banana tree, he was understood to remark that there was only one thing needed to render his new artillery system an entire success—that was to get the enemy to adopt it.

The *New York Times*, in an editorial of December 22, 1884, said :

Experts have differed about the practicability of the submarine gun system of the *Destroyer*, the child of Captain Ericsson's old age, just as they differed about the practicability of the monitor system, the child of his prime of life, and, for all we know about that of the motive power of the *Princeton*, the triumph of the earlier days of that part of his career which has been devoted to naval engineering. But although doubtful or

adverse comments, both official and unofficial, might be quoted, yet Congress, on the other hand, has the expressed and recent opinion * * * of the naval Board of Investigation that "the Ericsson submarine torpedo is a projectile of the most formidable character within a limited range," and "within that range is superior to any other known form of torpedo."

In those countries where the torpedo-boat has entered as a permanent element of defence, the great value of submarine gunnery is conceded. In this connection it can be said without doubt that the *Destroyer* represents the most advanced experiment.

To acquire the greatest good from an invention, we should accept it at the highest stage of its development; and, since Captain Ericsson has made many of those experiments which the government must have made itself had it been the possessor of the invention, it would seem that the most advantageous and economical action would be to purchase the *Destroyer*, particularly as the cost would be less than that of any other vessel the government would be likely to construct for a continuance of the development of submarine artillery. Further, all the time requisite for the construction of another vessel would be saved to experiment.

In conclusion, I desire to call attention to the advantages of submarine gunnery.

Although the Whitehead torpedo is a commercial success, and as a mechanical instrument is nearly perfect, it must be remembered that the power of

QUESTIONS OF THE DAY.

XIV. "The Jukes." A Study in Crime, Pauperism, Disease, and Heredity. By R. L. Dugdale. Octavo, cloth . . 1 00

XV. Protection and Communism. By Wm. Rathbone. Octavo, paper 25

XVI. The True Issue. By E. J. Donnell. Octavo, paper . 25

XVII. Heavy Ordnance for National Defence. By Wm. H. Jaques, Lieut. U. S. Navy. Octavo, paper . . . 25

XVIII. The Spanish Treaty Opposed to Tariff Reform. By D. H. Chamberlain, Jno. Dewitt Warner, Graham McAdam, and J. Schoenhof. Octavo, paper 25

XIX. The History of the Present Tariff. By F. W. Taussig. Octavo, cloth 75

XX. The Progress of the Working Classes in the Last Half Century. By Robt. Giffen. Octavo, paper . . 25

XXI. The Solution of the Mormon Problem. By Capt. John Codman. Octavo, paper 25

XXII. Defective and Corrupt Legislation; the Cause and the Remedy. By Simon Sterne. Octavo, paper . . 25

XXIII. Social Economy. By J. E. Thorold Rogers. Octavo, cloth 75

XXIV. The History of the Surplus Revenue of 1837. By Edward G. Bourne. 12mo, cloth 1 25

XXV. The American Caucus System. By George W. Lawton. Octavo, cloth, $1.00; paper 50

XXVI. The Science of Business. By Roderick H. Smith. Octavo, cloth 1 25

XXVII. The Evolution of Revelation. By James Morris Whiton, Ph.D. Octavo, paper 25

XXVIII. The Postulates of English Political Economy. By Walter Bagehot. Octavo, cloth 1 00

XXIX. Lincoln and Stanton. By Hon. W. D. Kelley. Octavo, cloth, 50 cents; paper 25

XXX. The Industrial Situation. By J. Schoenhof. Octavo, cloth 1 00

XXXI. Ericsson's Destroyer. By Wm. H. Jaques, Lieut. U. S. Navy. Octavo, paper, illustrated 50

G. P. PUTNAM'S SONS, Publishers, New York and London.